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1991 GORDON RESEARCH CONFERENCE ON HOLOGRAPHY AND
OPTICAL INFORMATION PROCESSING

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13. ABSTRACT (Maximum 200 words) The 1991 Gordon Research Conference on Holography and Optical Information Processing was held at Plymouth State College in Plymouth, NH on 17-21 June, 1991. The conference was attended by some 100 research scientists and engineers. There were 19 invited talks and 45 poster papers covering various aspects of the fields. The report includes the chairman's observations, the conference program, and a list of attendees.				
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Gordon Conference Chairman's Observations

John F. Walkup
Texas Tech University
Chairman, 1991 Gordon Conference on
Holography and Optical Information Processing

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The 1991 Gordon Research Conference on Holography and Optical Information Processing was held on 17-21 June, 1991 at Plymouth State College in Plymouth, NH. The conference was chaired by Professor John F. Walkup of Texas Tech University and the vice-chairman was Professor Francis T.S. Yu of Pennsylvania State University. The conference was attended by some 100 research scientists and engineers engaged in various aspects of holography and optical information processing. There were 19 invited talks on the frontiers of the two fields. These were arranged in some seven regular sessions. In addition there were two poster sessions in which a total of approximately 45 poster papers were presented. At the final business meeting of the conference, Professor W. Thomas Cathey of the University of Colorado-Boulder was chosen as vice-chairman of the 1993 conference which will be chaired by Professor Yu. The 1993 conference will be held in the northeastern U.S. at a site to be negotiated between Professor Yu and the Gordon Conference office.

Of the 19 invited talks, 5 were presented by foreign scientists and 14 by US scientists. Of the nine discussion leaders, 2 were foreign and 7 were US scientists. Of the 49 scientists who received assistance from the special fund either for travel and/or registration expenses, 27 were speakers or discussion leaders, 16 were graduate students, and 6 were other attendees. Some 11 of the 49 receiving assistance were foreign. The financial assistance (totaling \$28,000) came from the following sources: Gordon Conference office (\$12,000), Air Force Office of Scientific Research (\$5500), Army Research Office (\$5000), and Defense Advanced Research Projects Agency (\$5500). The financial assistance was invaluable in making this one of the best attended of our 10 Gordon Research Conferences in this area. It is interesting to note that 10 of the 100 attendees had also attended the first Gordon Conference in 1972.

While it is not appropriate to go into a detailed analysis of the 19 papers presented at the conference, I will attempt to note some of the highlights here. The initial presentation on "Atom Optics" by Professor David Pritchard of M.I.T. was quite stimulating in that the idea of using light waves to diffract matter waves is, to say the least, unconventional. The novel concept of atom interferometers and other submicron structures was also stimulating and well

received. Professor Bahaa Saleh of the University of Wisconsin-Madison presented a paper on "Optical Processing with Nonclassical Light" which pointed out both the promise and the difficulty of using "squeezed" light to reduce noise limitations in optical processors. Another well received paper was Professor Adolf Lohmann's talk on "What Optics Can and Cannot Do for the Computer". By getting into the frequently used computer concept of complexity theory and relating it to commonly understood optics concepts such as space-bandwidth product, and resolvable elements, he was able to give new meaning to terms such as speed and parallelism as relates to optical computing. A major point he made is that we in optics need to learn to express our ideas in a way which computer scientists and engineers will understand, so as to stimulate mutual interaction between the two communities.

The talks on "Ultrafast Optical Logic Using Solitons" and "Optical Processing with Planar Optics" by Dr. Mohammed Islam and Dr. Jurgen Jahns, respectively, of A.T. & T. Bell Laboratories pointed out the significant progress being made by various Bell Labs investigators on various aspects of optical computing. It is clear that the team headed by Dr. Alan Huang is making significant progress in overcoming the formidable barriers to developing an optical computer. Professor Sing Lee from the University of California-San Diego gave an excellent overview of some "Engineering and Performance Issues in Optoelectronic Computing". Both Sing Lee, and Professor Kristina Johnson of the University of Colorado-Boulder pointed out that while the current state-of-the-art is approximately 10^9 interconnections per second, Bellcore is already talking about 10^{13} interconnects/sec in the near future.

A highlight of the conference was the reception given to the foreign papers presented by Professor Sergei Kulakov ("Acousto-Optics in the Soviet Union"), Dr. Satoshi Ishihara ("Optical Computing in Japan") and Professor Jumpei Tsujiuchi ("Display Holography in Japan"). It is clear that the Soviets have made considerable progress on multi-transducer AO spectrum analyzers. It is also clear that the Japanese government is planning to continue to make optical computing one of its high priority areas, with its NIPT (New Information Processing Technology project), and are projected to continue to investigate so called "Sixth Generation" computer technologies. A number of workshops will be run by the Japanese organization MITI, and if the outcomes of the workshops are positive, NIPT is slated to start in April of 1992. The last of these three particular foreign presentations, that of Professor Jumpei Tsujiuchi on "Display Holography in Japan" was, to put it mildly, fantastic. It became very clear that the Japanese are now the world leaders in the area of display holography research.

A series of three papers by Drs. John Hong and Arthur Chiou of Rockwell International Science Center and Professor Keith Jenkins of USC highlighted recent research in "Adaptive Optical Neural Networks", "Reconfigurable Optical Interconnections Using Photorefractive Holograms", and "Optical Interconnects for Neural Networks", respectively. While it is true that much progress had been made in these areas, it is also clear that more progress still needs to be made if optical neural nets are to compete with VLSI-based networks. The comment was made, and widely agreed with, that optics may not be preferable for the learning phase of a neural network, so hybrid electronic-optical networks may be mandatory, at least in the near term.

On the final morning of the conference the optical signal processors felt like we received a shot in the arm. First, Dr. Joe Horner of Rome Laboratory (Hanscom AFB) noted that a recent "shootout" between optical and digital pattern correlators held at the Army's Night Vision Laboratory had been won by the optical correlators. Secondly, Professor Urs Wild of the Swiss Federal Institute of Technology presented a paper on "Spectral Hole-Burning: Applications to Data Storage and Processing-The Molecular Computer" which amply documented some of the extremely exciting possibilities of spectral hole burning in optical processing and storage. Finally, Dr. Ravinder Kachru of SRI International presented some of his recent work on "Image Storage and Processing Via Stimulated Photon Echoes" which makes it clear that photon echoes potentially provide a technique for reading, writing, and processing optical data extremely fast-i.e. read/write rates of 10^{10} bits/sec and storage densities of 10^{13} bits/cm³. It is clear that temporal correlations can be performed very rapidly on images using this novel technique. These final two papers, in particular, were very well received and gave many of us a lot of encouragement for the future of our field.

In summary, the general consensus appeared to be that the meeting had continued the tradition of stimulating presentations on the frontiers of science in the fields of holography and optical information processing. The attendees all seemed to be looking forward to the 11th conference, to be held in 1993.

1991 Gordon Research Conference

HOLOGRAPHY & OPTICAL INFORMATION PROCESSING

June 17-21, 1991

Plymouth State College (S)
Plymouth, New Hampshire

Chairman: John F. Walkup
Vice-Chairman: Francis T.S. Yu

Monday, June 17, Morning Session

- 8:45 a.m. JOHN F. WALKUP, Texas Tech University - Welcome
- 9:00 a.m. HARRISON H. BARRETT, University of Arizona - Presider
- "Atom Optics"
DAVID E. PRITCHARD, MIT
- "Optical Processing with Nonclassical Light"
BAHAA E.A. SALEH, University of Wisconsin at Madison
- 10:45 a.m. BREAK
- 11:15 a.m. "Optical Scanning Holography"
TING-CHUNG POON, Virginia Polytechnic Institute and
State University

Monday Evening Session

- H. JOHN CAULFIELD, University of Alabama in Huntsville -
Presider
- 7:30 p.m. "What Optics Can and Cannot Do for the Computer"
ADOLF W. LOHMANN, NEC Research Institute/University of
Erlangen, Germany
- 8:25 p.m. "Ultrafast Optical Logic Using Solitons"
MOHAMMED N. ISLAM, A.T. & T. Bell Laboratories

Tuesday, June 18, Morning Session

ADOLF W. LOHMAN, NEC/University of Erlangen - Presider

- 3:55 a.m. "Engineering and Performance Issues in Optoelectronic Computing"
SING H. LEE, University of California at San Diego
- 9:50 a.m. "Optical Processing with Planar Optics"
JURGEN JAHNS, A.T. & T. Bell Laboratories
- 10:45 a.m. BREAK
- 11:15 a.m. "VLSI and Liquid Crystal Spatial Light Modulators for Optical Computing Architectures"
KRISTINA M. JOHNSON, University of Colorado at Boulder

Tuesday Evening Session

- 7:30 to 10:00 p.m. POSTER SESSION I: FRANCIS T.S. YU, Pennsylvania State University - Presider

Wednesday, June 19, Morning Session

- 8:55 a.m. EMMETT N. LEITH, University of Michigan - Presider
"Massively Parallel Optical-to-Electronic Data Transfer"
CARL M. VERBER, Georgia Institute of Technology
- 9:50 a.m. "Acousto-Optics in the Soviet Union"
SERGEI V. KULAKOV, Leningrad Institute of Aviation Instrument Making, USSR
- 10:45 a.m. BREAK
- 11:15 a.m. "Optical Computing in Japan"
SATOSHI ISHIHARA, Electrotechnical Laboratory, Japan

Wednesday Evening Session

TUNG H. JEONG, Lake Forest College - Presider

- 7:30 p.m. "Synthetic 3-D Holography"
STEPHEN A. BENTON, Media Laboratory, MIT
- 8:25 p.m. "Display Holography in Japan"
JUMPEI TSUJIUCHI, Chiba University, Japan

Thursday, June 20, Morning Session

BERNARD H. SOFFER, Hughes Research Laboratories - Presider

8:55 a.m. "Adaptive Optical Neural Networks"
JOHN H. HONG, Rockwell International Science Center

9:50 a.m. "Optical Interconnects for Neural Networks"
B. KEITH JENKINS, University of Southern California

10:45 a.m. BREAK

11:15 a.m. "Reconfigurable Optical Interconnections Using
Photorefractive Holograms"
ARTHUR E. CHIOU, Rockwell International Science Center

Thursday Evening Session

7:30 p.m. Business Meeting and Informal Presentations: JOHN F. WALKUP,
Texas Tech University - Presider

8:30 to POSTER SESSION II: FRANCIS T.S. YU, Pennsylvania State
10:00 p.m. University - Presider

Friday, June 21, Morning Session

A.A. FRIESEM, Weizmann Institute of Science - Presider

8:30 a.m. "A Random Walk Through Phase Space"
JOSEPH L. HORNER, Rome Laboratory, Hanscom AFB

9:25 a.m. "Spectral Hole-Burning: Applications to Data Storage and
Processing - The Molecular Computer"
URS P. WILD, Swiss Federal Institute of Technology

10:20 a.m. "Image Storage and Processing Via Stimulated Photon Echoes"
RAVINDER KACHRU, SRI International

11:30 a.m. Lunch

THE LAST CONFERENCE ACTIVITY IS LUNCH ON FRIDAY.

THE LOGAN AIRPORT BUS LEAVES AT 12:00 p.m.